Increasing Adoption of Residential Wood Energy: Past, Present, & Future

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Maryland Wood Energy Coalition

Organized April 2010

Objectives:

- Committed to increasing the adoption of high efficiency, low emission wood energy technologies that meets Maryland air quality standards.
- Best achieved through:
  - small to medium-sized commercial and institutional applications for government, schools, and businesses
  - residential thermal applications.

Sources of Renewable Energy?

- Solar
- Wind
- Hydro
- Geothermal
- Woody biomass

Solar, Wind, Hydro → Electricity
Geothermal → Thermal
Woody biomass → Thermal

- Perception of wood as a dirty fuel by policymakers, citizens, and others.
- Biomass barely mentioned in some states under renewables
- Biomass is defined as "carbon-neutral" by EPA

Do You Heat with any of the following?

Mark all that apply

1. Wood stove
2. Pellet stove
3. Inside wood furnace
4. Outdoor wood boiler
5. Fireplace

Fossil Fuel Reduction of a $2,000 Wood/Pellet Stove = Fossil Fuel Reduction of a $20,000 Solar PV

- Both systems can displace equal amounts of carbon from fossil fuel: 3 tons.
- 1 kw system, 1 cord of wood or 1 ton of pellets all displace about 1 ton of carbon from fossil fuels.

What is Woody Biomass?

- Native forests
- Sawmill residue
- Urban wood waste – tree removals
- Short rotation woody crops (SRWC)

Why The Increasing Interest in Wood?

- Enjoy the ambience & heat, part of culture
- Save money on heating – 60% of people who heat with wood cut their own.
- Have access to free wood
- Heat security – less so for pellet heat
- Augment a heat pump, replace propane, oil
- Environmentally responsible

Types of Residential Wood Stoves

Free Standing Stoves/Inserts

- Wood stoves – use firewood. Most difficult to control emissions
- Pellet stoves – standardized fuel & low emissions

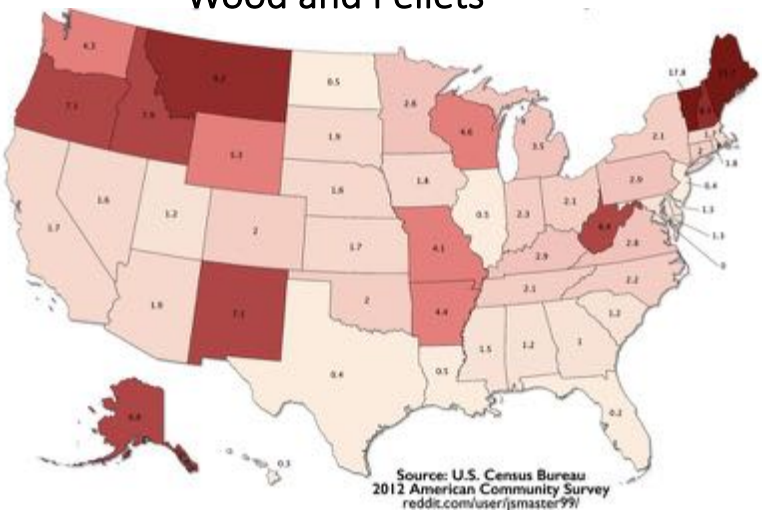
Wood & Pellet Furnaces

- Expensive - more popular in colder climates

Outdoor Wood Boilers

- High emissions & set bad image for wood-burning

Homes Heated Primarily by Wood and Pellets

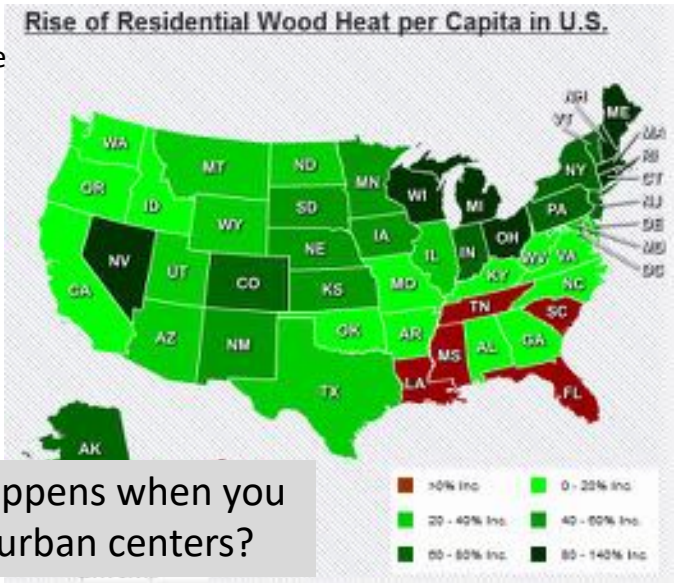


Highest per capita primary wood heat households per state

- Gillam county, OR 40%
- Pendleton, WV 39%
- Lincoln county, MT 39%
- Lewis county, NY 26%
- Grafton county, NH 17%
- Piscataquis, ME 16%
- Garrett county, MD 12%
- Kemper County, MS 10%

Source: Alliance for Green Heat

2.1% of families use wood or pellets as primary heat; 10% use it as secondary heat



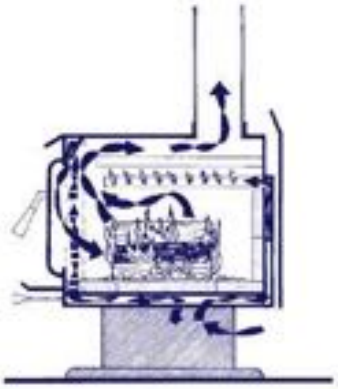
What happens when you remove urban centers?

Barrier Use of Wood is Wood Smoke How to Solve the Problem?

- Major problem is mountain/valley areas
- Many areas outlawing wood stoves
- Trying to transition users to pellet stoves?
- Will wood users transition to pellets?
- Incentives? Do they work?

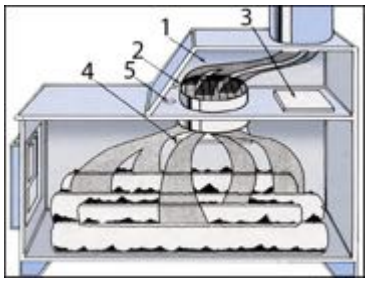
Enter the EPA in 1988

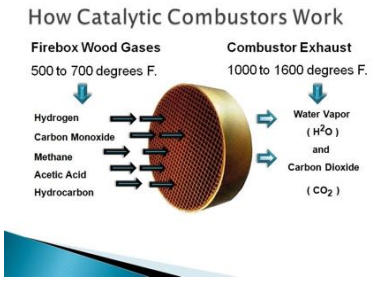
- Pre-1988 – no EPA certification
- After 1988 - emissions less than 7.5 grams/hr.
- Many companies ceased business (Timberline, Fisher, etc)
- Lower emissions = higher efficiency = savings for consumer
- Smoke is basically unburned fuel and increases emissions.



Pre-EPA Stoves vs. Certified Stoves

Catalytic Converters





- After EPA certification some manufacturers added catalytic combustors to reduce emissions

Effect of Wood Stove Efficiency on Fuel Cost

Cost per million Btu's for a cord of oak purchased for $150

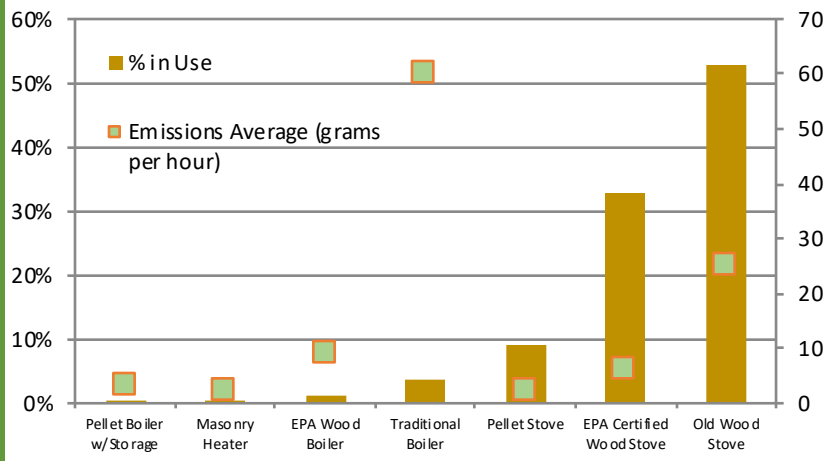
Fireplace
10% efficient
$59 per million Btu's

Non EPA Woodstove
40% efficient
$14.7 per million Btu's

EPA Wood Stove
70% efficient
$8.5 per million Btu's

- Point: Whether you buy wood or cut it yourself, there are large efficiency savings and health savings from reduced smoke.

Most Wood Heating Equipment is Outdated and Too Polluting

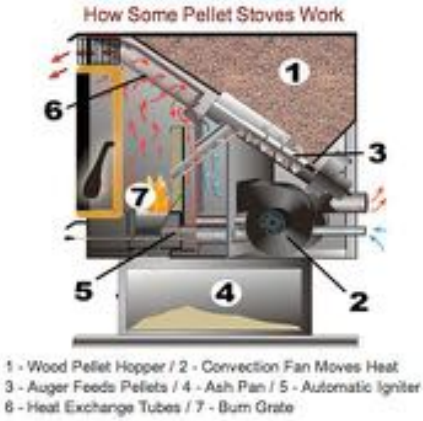


Pellet stoves

- Come a long way
- Emissions under 2.5 grams per hour
- Only require a small vent pipe
- May require repair. Requires electricity.
- Uses 40 lb bag of pellets

How Pellet Stove Work

- Highly automated
- Hopper holds pellets
- Augur meters pellets
- Augur designs vary - reliability
- Common problem is clogging
- Ash content of pellets affects operation



Wood Pellets

- Difference in quality – standardization by industry (<0.5% ash)
- 40 lb bags and pallets a problem for some
- Bulk delivery available in some NE states.

Pellet Stoves & Furnaces

- Home pellet systems are available with various hopper storage systems.
- Order pellets early to get best prices.

2015 - New Source Performance Standards (NSPS) for Residential Wood Heaters - EPA

- 1988 – All wood stove must have less than 7.5 grams/hr of particulate emissions
- 2015 – All wood stove must have less than 4.5 grams/hour of particulate emissions.
- 2020 – Emission limit of 2.0 grams/hr with cribwood, or 2.5 grams/hr with cordwood

Verified Efficiencies of Wood & Pellet Stoves

- After 2015 must be verified by EPA
- Previous claims by manufactures not reliable
- More efficient, less fuel

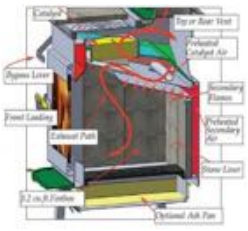
Average verified efficiencies:
- **Wood stoves (111) = 72%**
- hybrids (6) = 78%
- catalytic (20) = 78%
- non-catalytic (84) = 71%
- **Pellet stoves (63) = 73%**

Average emissions (g/hr):
- **Wood stoves = 2.5**
- hybrids = 0.9
- catalytic = 1.5
- non-catalytic = 2.8
- **Pellet stoves = 1.2**

(verified efficiency stoves only)

How will technology change to meet 2020 emission standards?

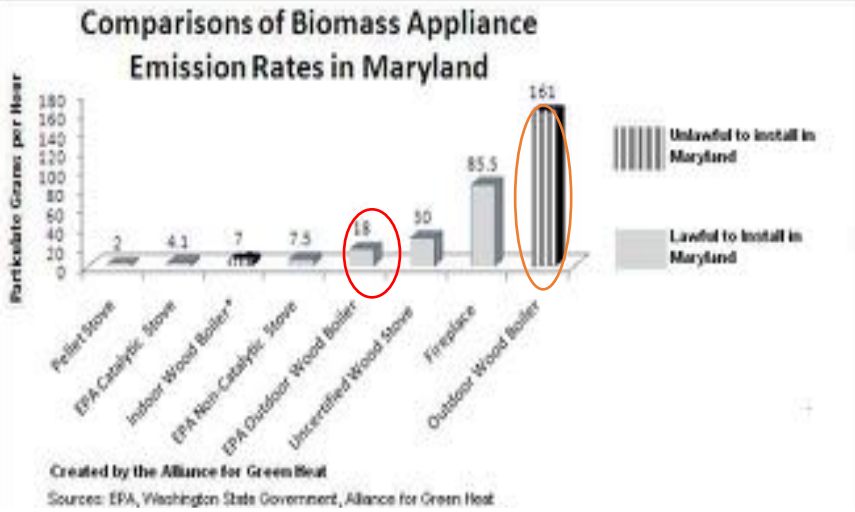
- Many manufacturers going back to catalytic stoves. 2 grams / hr not difficult
- Hybrid stoves may become more popular – catalytic & non-catalytic components
- Smart stoves



New EPA regulations bringing many positive changes

- Disclosure of efficiencies will result in higher efficiencies, helping consumers save more $
- Disclosure of real BTU output, end to misleading/false advertising
- Requiring all stoves to be certified
- Ending sales of worst outdoor boilers
- Spurring innovation

What about Wood Boilers?



Wood Boilers – Outdoor Hydronic Heaters

- 2015 EPA Regulation - must be EPA Step 1 qualified (formerly Phase 2)
- In 2020, Step 2. Will be hard to meet. Industry sued EPA.
- Problems: Old wood boilers still allowed but all stoves must burn clean fuels only.

Changing the Polluting Image of the Outdoor Wood Boiler

Older boiler

EPA Step 1 (Phase II)

Outdoor Wood Boilers Best Practices

- Size for less than maximum heat need – don't oversize
- Minimize distance from stove to home
- Bury and insulate water transfer line
- Use only clean and dry (20% moisture) fuelwood
- Unseasoned wood will not work

Recent Development with NSPS Regs from EPA

- Of 514 wood stoves on the market, 17% are now certified to 2020 emission standards.
- Manufacturers with most stove models least prepared for stricter emissions (Hearth & Home Technologies, Jotul, US Stove)
- Lobbying by outdoor wood boiler industry to delay implementation.
  - 1-3 year delay possible

What would motivate you to buy a cleaning burning wood stove?

1. Monetary incentive
2. Environmental responsibility
3. Your neighbors / community
4. A cold family member
5. If I had the money
6. Find one used
7. Other

Change Out Programs

- In 2016, there were 35 stove change-out programs.
- The average incentive was about $900 to replace an old wood stove with a new one, $1,300 for a pellet stove

<u>Maryland Wood Grant Program (2012-2017)</u>

- 5,398 stoves – 89% pellet stoves
- $700 for pellet - $500 for wood
- $2.1 million total

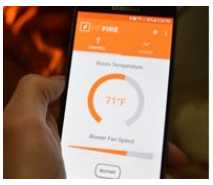
Cheap vs. Expensive Stoves

- Little correlation between grams per hour, efficiency and price of a stove. Englander 30-NC cost $1,200 and is 1.4 grams an hour, and possibly most popular stove in the US.
- Up to half of stove in the US are bought at big box stores for around $1,500.
- Some are among cleanest and most efficient available.

Automated (Smart) Stoves

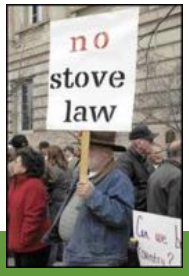
MF**FIRE**

- Heat Output: 10,000 to 60,000 BTU/hour
  Smart Efficiency: 90%
  EPA Emissions: 1.9 g/hr
  EPA Efficiency: 70 %Fire
- Winner 2013 Woodstove Decathlon
- Commercial their product



Public opinion and anti-wood burning regulations

- Public opinion in much of the country not leaning toward wood burning.
- Wood pellet movement is helping public opinion.
- Anti-wood burning groups growing and making headway in populated areas.
- Outdoor wood boilers galvanize anti-smoke activists.



Options to reduce wood smoke

- Reduce number of wood stoves
- Reduce number of uncertified wood stoves
- Move from wood to pellet stoves
- Ensure that fuel is seasoned – or us compressed bricks

Role of Firewood ...

- 60% of wood users source cut their own wood
- 6-12 months+ to season wood to 20% moisture
- Problems:
  - Homeowners don't buy early enough
  - Homeowners don't run stoves well or season wood
  - Many retailers claim wood is seasoned when its not. No label or certification for seasoned wood

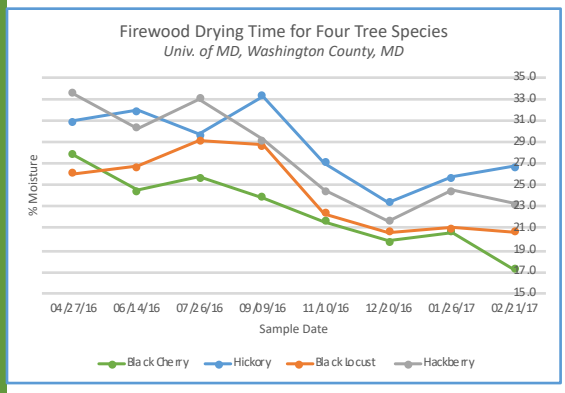
Seasoning Firewood

- Hardwood requires at least 6-9 months after split and covered.
- 20% moisture before burning
- Wetter wood - fewer Btu's and burns poorly- produces CREOSOTE!
- The more wood surface exposed to air, the faster it dries.
- Roofs better than tarps.

Freshly cut oak

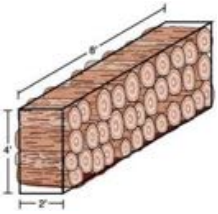
I year later.

Firewood Seasoning – 6 – 9 Months
Target 20% Moisture

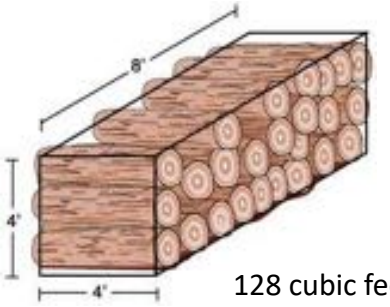


How Much is A Cord?

- A cord is 128 cubic feet equal to a closely stock split wood that is 4’ tall x 4’ wide x 8’ long. Or an other combination.



Face cord (4’ x 2’ x 8’)



128 cubic feet (4’ x 4’ x 8’

How much does the wood weigh?

Species	Green Weight	Dry Wt (20%)	Million Btu's/cord
Oak, Red	4888	3528	24.6
Walnut, Black	4584	3192	22.2
Cherry	3696	2928	20.4
Ash, Green	4184	2880	20.0
Sycamore	5096	2808	19.5
Maple, Silver	3904	2752	19.0
Boxelder	3589	2632	18.3
White Pine		2250	15.9

Question: Can a half ton truck deliver a cord of wood?

How Much Does A Truck Hold?

Truck Type	Cubic Foot Volum	Loading methods	Stacked to top of box	Stacked above top of box
1978 Dodge longbed	73 cub. Ft.	Random Stacked	0.35 0.47	0.44 0.58
1981 Ford shortbed	62 cub. Ft.	Random Stacked	0.30 0.39	0.37 0.48
1976 Datsun pickup	39 cub. Ft.	Random Stacked	0.18 0.24	0.23 0.31

Pickup trucks hold from a $^1/_5$ to ½ of a cord Depends how stacked. 30% difference!

Marsinko& Wooten. 1982. Forestry Bulletin 30, Dept. of Forestry, Clemson University, SC

Delivery Principles

- Sourcing wood…
- BEFORE the wood is unloaded:
  - Check the volume - Is it a full cord?
  - Check the moisture – buy a moisture meter
- Problem! Refuse, negotiate, act in good faith!
- State requirements for sale?
- If an honest cord , seasoned, and good service? Tell others!

European model: deliveries on pallets Volume & moisture content consistent

Kiln drying

Cutting Your Own Wood -Tools & Equipment

Truck or trailer not shown

Chainsaw
Safety gear

Bow saw

Log splitter

Ax

Peavey for
moving logs

Rules For Chopping Your Own Wood

1. Never park down hill of a tree you are cutting.
2. When in doubt, park twice as far from the tree as the tree is tall.
3. Just because you live within driving distant of a forest, does not make you a Lumber Jack.
4. Always use the neighbors truck.

Potential of Firewood Associations

- Establish best practices to improve delivery of full cords of dry wood.
- Require firewood dealers to document moisture content.
- Yelp type website that rates firewood dealers

NFA
NATIONAL FIREWOOD ASSOCIATION

NF BOIS de chauffage

AFPDA
American Firewood Producers and Distributors Association

4th WoodStove Design Challenge: National Mall -Washington, D.C. November 9-14, 2018

Woodstove Decathlon

- Automation of the wood stove - 21st century technology like sensors and WIFI-enabled controls.
- Thermoelectric wood stoves that generate electricity

ALLIANCE FOR GREEN HEAT
clean, renewable & local

Conclusions

- Remove polluting wood stoves by encouraging buyout /incentive programs
- Improve seasoning of wood by all – buy a meter
- Improve professionalism of the firewood industry and how it works with consumers
- Market pellet stoves as clean & efficient for new users.
- Best practices for outdoor wood boilers
- Partner to educate users & industry

Website: www.extension.umd.edu/woodland

- 9 residential wood energy fact sheets
- YouTube videos
- Webinars

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